

Air Traffic Control Seminar

Seminar Welcome

Hosted by Gano Chatterji, UARC
and Bill Preston, QSS Inc.,

NASA Ames Research Center

Moffett Field, California

July 5-6, 2006



Seminar Objectives:

- **Provide an understanding of the existing US Air Traffic Control System with an overview of operations at:**
 - **Air Traffic Control Towers (ATCT)**
 - **Terminal Radar Approach Controls (TRACON)**
 - **Air Route Traffic Control Centers (ARTCC)**
 - **Oceanic Control (at selected ARTCCs)**
 - **Air Traffic Control System Command Center (ATCSCC)**

Seminar Objectives: (cont'd)

Participants Will Gain an Understanding of:

- **Controller's Duties and Responsibilities**
 - For each type of facility
- **Separation Requirements**
 - For each type of facility
- **Tools and Equipment Used by ATC**
- **The Traffic Management System**
 - Structure
 - Programs
 - Equipment
- **Future ATM Systems**

Presenters:

- **NASA Ames:**

- Bill Preston, QSS Inc, Airspace Systems Program
- Gano Chatterji, UARC, Code AFM
- Harry Swenson, NASA Ames

- **FAA:**

- Greg Kingery, SFO ATCT
- Rick Coté, Northern California TRACON
- Wes Hall, Oakland ARTCC
- Dennis Addison, Oakland ARTCC Oceanic

ATC Seminar Schedule:

Wed, July 5th

- 9:00AM** Introduction – Bill Preston and Gano Chatterji
- 9:30AM** Tower Operations – Greg Kingery, SFO ATCT
- Noon** Lunch (not provided)
- 1:00PM** En Route Center Operations – Wes Hall, ZOA
- 3:00PM** Oceanic Operations – Dennis Addison, ZOA Oceanic

Thu, July 6th

- 9:00AM** NGATS Overview – Harry Swenson, PI NGATS Airspace
- 10:00AM** TRACON Operations – Rick Coté, Patty Daniel, NCT
- Noon** Lunch (not provided)
- 1:00PM** Traffic Management Operations/ Tools/Systems – Wes Hall and Gano Chatterji
- 4:00PM** Future Systems/Discussion/Q&A

Seminar Plan

- Sessions scheduled from 9am to 5pm
- Refreshments/snacks in AM and PM
- Lunch not provided (Ames Deli and McDonalds are options at Ames)
- During sessions, questions are encouraged
- “Parking Lot” issues

Web References

- **FAA reference links:**
 - FAA Main Website: <http://www.faa.gov>
 - FAA AT Publications: <http://www.faa.gov/atpubs/>
 - ATCSCC Web:
<http://www.fly.faa.gov/Products/products.jsp>
 - ATO Online: <http://ato.faa.gov>
 - FARs: http://www.faa.gov/regulations_policies/
- **Upon completion of this seminar, briefings shown will be available online at:**
 - <http://as.nasa.gov/atcseminar/>

Acknowledgements

The starting point for this series of presentations was the ATC Seminar prepared by Barry Scott and Jim McClenahan of the FAA. Information presented in this seminar has been updated and expanded by our briefers.

Special thanks to our FAA briefers for all their work preparing and presenting these talks.

Introduction to Air Traffic Control

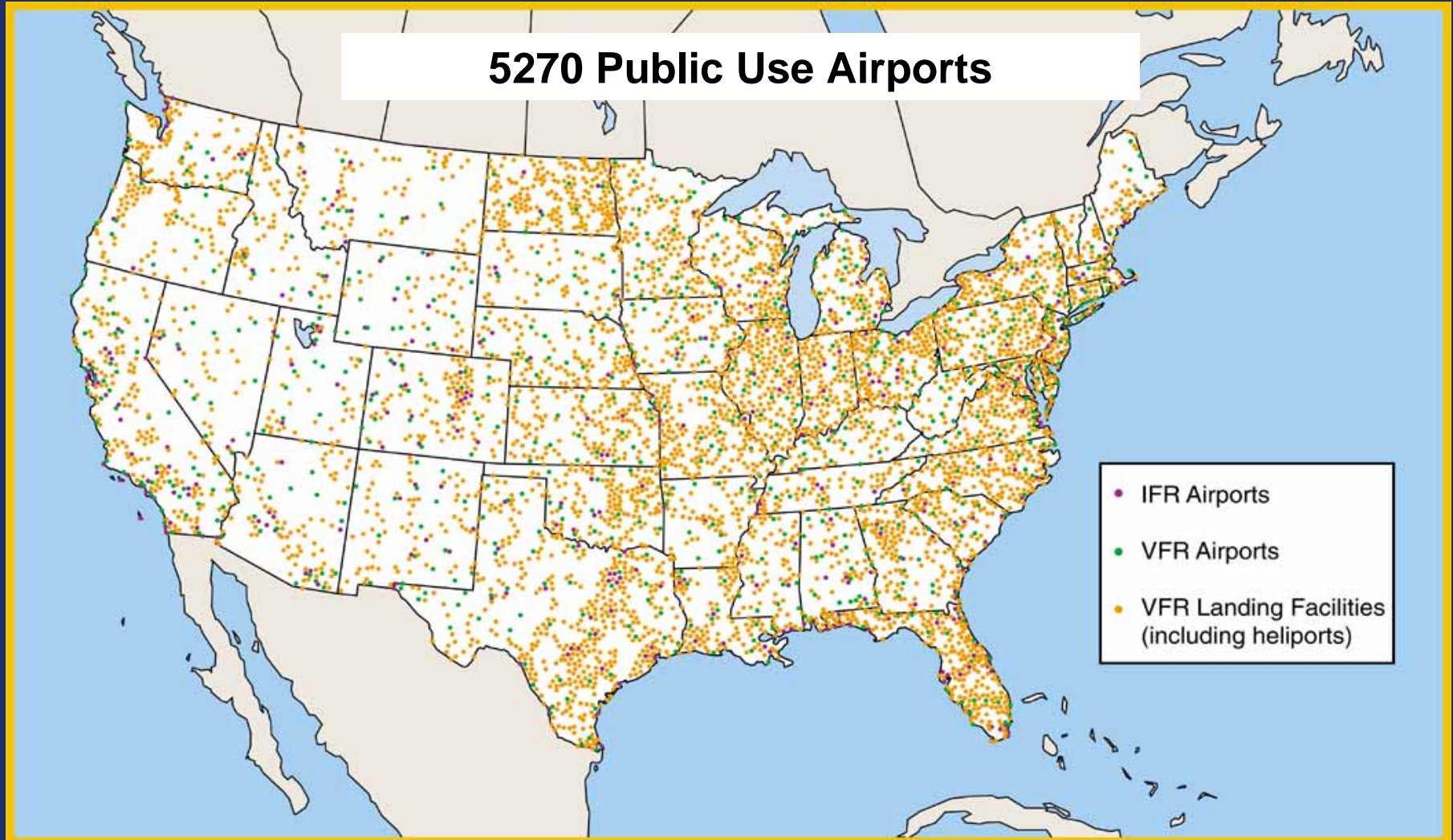
- **National Airspace System**
- **Air Traffic Control System**
- **Federal Aviation Administration**
- **Regulations, Directives and Rules**

National Airspace System (NAS)

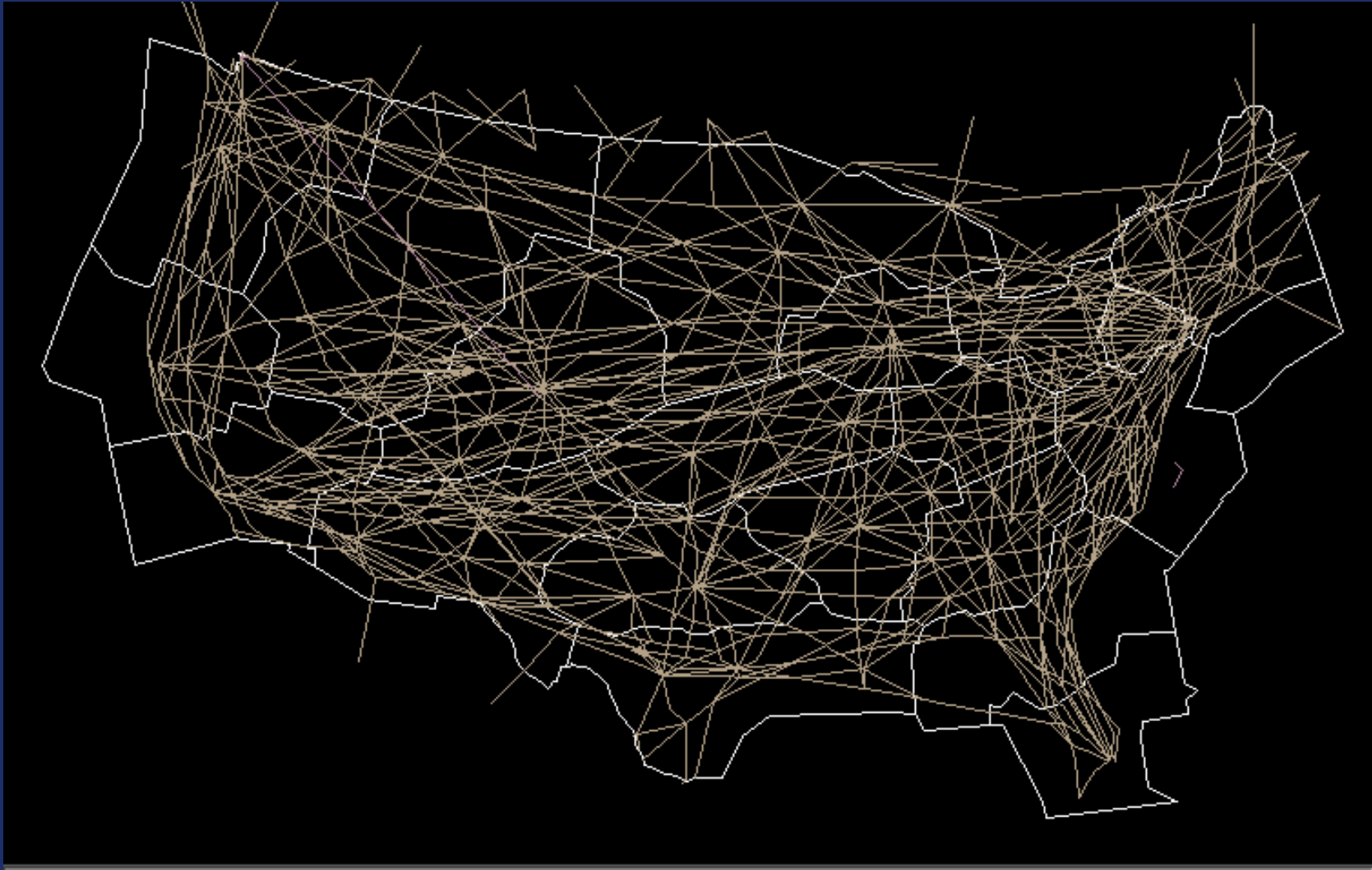
A network of airspace, air navigation facilities, equipment, services, airports or landing areas, aeronautical charts, information services, rules, regulations, procedures, technical information, personnel and material. Included in the NAS are system components shared jointly with the military.

- Over 609,000 active pilots in the US**
- Operating more than 280,000 aircraft, anything from large commercial aircraft to small private airplanes, helicopters, balloons and other craft.**

National Airspace System - Airports



National Airspace System - Jet Routes



National Airspace System (NAS)

Airports:

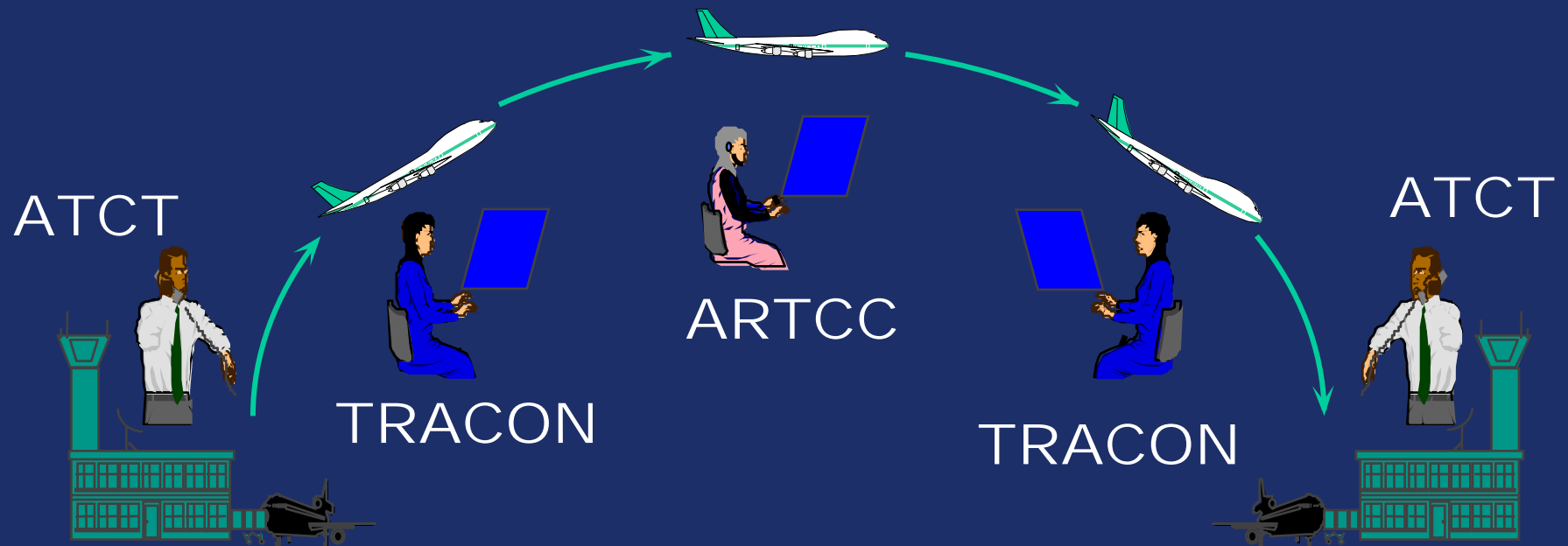
- **19,854 Airports in the US (including military and private fields)**
 - Public Use 5,270
 - Private Use: 14,584
- **Certificated airports*: 575 Civil**

Operations (CY05):

- **46,190,000 Airport Operations**
- **48,029,000 Instrument Operations**
- **47,182,000 EnRoute Operations**
- **773 billion Air Carrier Revenue Passenger Miles**

*Certificated airports serve Air Carrier Operations with aircraft seating more than 9 passengers seats. (FAR Part 139).

The diagram illustrates the ATCSCC (Air Traffic Control Satellite Communication Cell) system architecture. It features a central ground station with a person operating a computer, labeled "ATCSCC". This ground station is connected via red lightning bolts (representing satellite communication) to two satellites in orbit. Each satellite is further connected via red lightning bolts to multiple aircraft, symbolizing the network's role in facilitating communication between ground control and multiple aircraft simultaneously.



US Air Traffic Control Facilities

Flight Service facilities:

- **58 Flight Service Stations (FSSs)**
 - Under contract w/Lockheed Martin

Terminal facilities:

- **517 Air Traffic Control Towers (ATCTs)**
- **185 Radar Approach Controls (TRACONs)**

Enroute facilities:

- **21 Air Route Traffic Control Centers (ARTCCs)**

Air Traffic Control System Command Center (ATCSCC):

- National air traffic management facility
- Herndon, VA

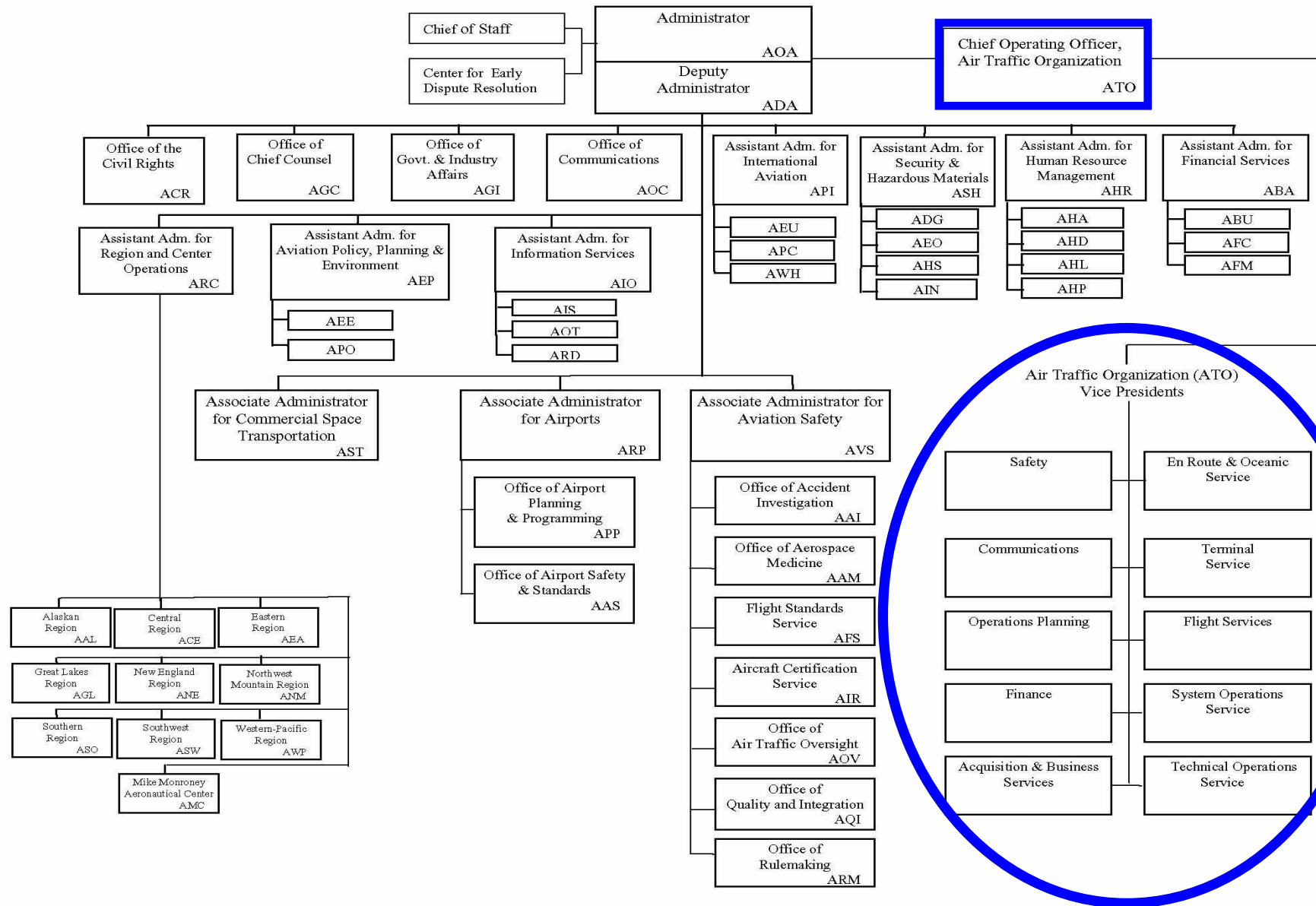
Federal Aviation Administration

FAA part of the US Department of Transportation

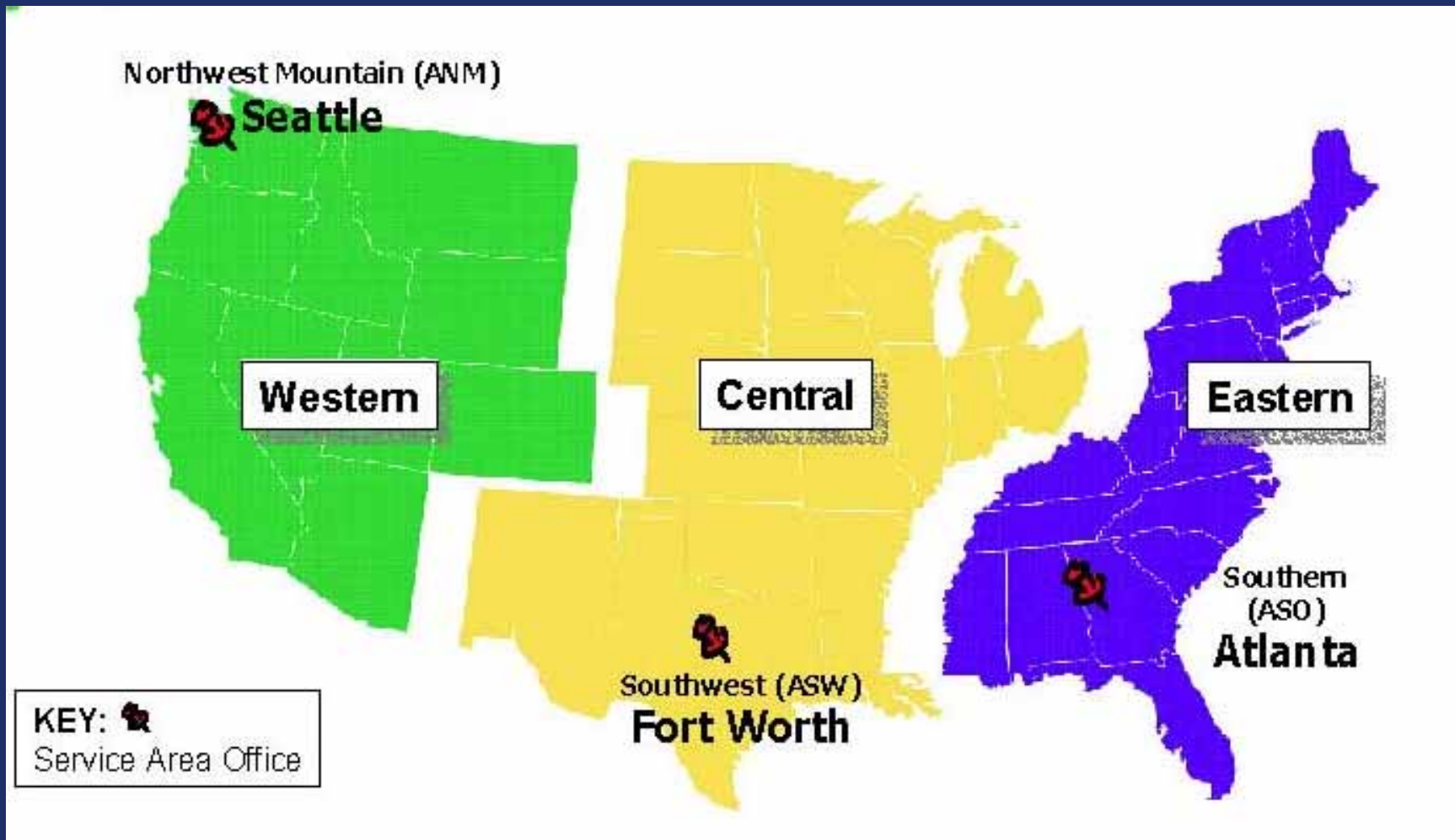
- **Employment FY05 - 45,730**
 - Air Traffic Controller Workforce: 16,633
- **FAA Budget FY05: \$13.8B**
 - \$7.7B Operations
- **Air Traffic Organization (ATO) – A performance based organization within FAA created in 2003. Includes all ATC operations.**

As of January 18, 2006

FEDERAL AVIATION ADMINISTRATION



ATO Organization – Service Areas



Governing Regulations and Directives

- **Code of Federal Regulations (CFR):**
 - The codification of the general and permanent rules published in the Federal Register by the executive departments and agencies of the Federal Government. It is divided into 50 titles that represent broad areas subject to Federal regulation.
- **Title 14 covers Aeronautics and Space which includes:**
 - Parts 1-499 – Federal Aviation Administration
 - Parts 1200-1299 - NASA

14 CFR - Aeronautics and Space

- **Includes numerous parts also known as Federal Aviation Regulations or FARs**
- **Examples:**
 - Part 1 - Definitions
 - Part 71 – Designation of classes of airspace
 - Part 73 – Special Use Airspace
 - Part 91 - General Operating and Flight Rules
 - Part 121 - Operating requirements: Domestic, flag, and supplemental operations
 - Part 135 - Operating requirements: Commuter and on-demand operations

Airspace Classification (14 CFR Part 71)

FL 600

CLASS A

18,000 MSL

CLASS E

14,500 MSL

*Typically up to
10000 AGL*

CLASS B

*Typically up to
4000 AGL*

CLASS C

*Typically up to
2500 AGL*

CLASS D

CLASS G

Non-towered
Airport

700
AGL

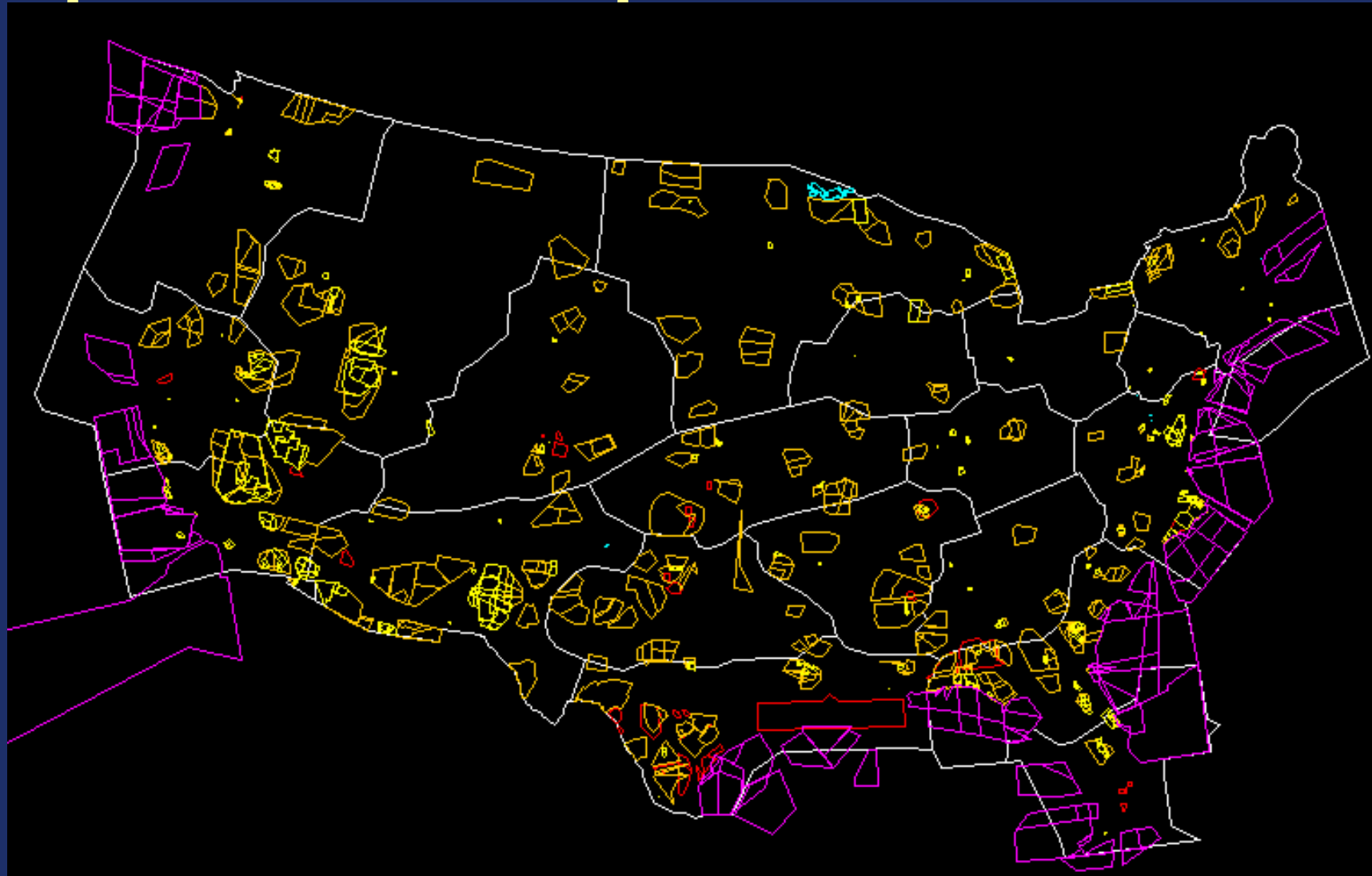
CLASS G

1200 AGL

FL=Flight level
MSL=Mean Sea Level
AGL=Above Ground Level

CLASS G (Uncontrolled Airspace) is
virtually all located in the western US

Special Use Airspace (14 CFR Part 73)



General Operating and Flight Rules

14 CFR Part 91

PART 91—GENERAL OPERATING AND FLIGHT RULES

SPECIAL FEDERAL AVIATION REGULATION No.
50-2
SPECIAL FEDERAL AVIATION REGULATION No.
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SPECIAL FEDERAL AVIATION REGULATION No.
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SPECIAL FEDERAL AVIATION REGULATION No.
104

Subpart A—General

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91.1 Applicability.
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pilot in command.
91.5 Pilot in command of aircraft requiring
more than one required pilot.
91.7 Civil aircraft airworthiness.
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91.13 Careless or reckless operation.
91.15 Dropping objects.
91.17 Alcohol or drugs.
91.19 Carriage of narcotic drugs, marihuana,
and depressant or stimulant drugs or
substances.
91.21 Portable electronic devices.
91.23 Truth-in-leasing clause requirement in
leases and conditional sales contracts.
91.25 Aviation Safety Reporting Program:
Prohibition against use of reports for en-
forcement purposes.
91.27-91.99 [Reserved]

Subpart B—Flight Rules

GENERAL

91.101 Applicability.
91.103 Preflight action.

91.115 Right-of-way rules: Water operations.
91.117 Aircraft speed.
91.119 Minimum safe altitudes: General.
91.121 Altimeter settings.
91.123 Compliance with ATC clearances and
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91.125 ATC light signals.
91.126 Operating on or in the vicinity of an
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91.127 Operating on or in the vicinity of an
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91.129 Operations in Class D airspace.
91.130 Operations in Class C airspace.
91.131 Operations in Class B airspace.
91.133 Restricted and prohibited areas.
91.135 Operations in Class A airspace.
91.137 Temporary flight restrictions in the
vicinity of disaster/hazard areas.
91.138 Temporary flight restrictions in na-
tional disaster areas in the State of Ha-
waii.
91.139 Emergency air traffic rules.
91.141 Flight restrictions in the proximity
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91.143 Flight limitation in the proximity of
space flight operations.
91.144 Temporary restriction on flight oper-
ations during abnormally high baro-
metric pressure conditions.
91.145 Management of aircraft operations in
the vicinity of aerial demonstrations and
major sporting events.
91.146-91.149 [Reserved]

VISUAL FLIGHT RULES

91.151 Fuel requirements for flight in VFR
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91.153 VFR flight plan: Information re-
quired.
91.155 Basic VFR weather minimums.
91.157 Special VFR weather minimums.
91.159 VFR cruising altitude or flight level.
91.161-91.165 [Reserved]

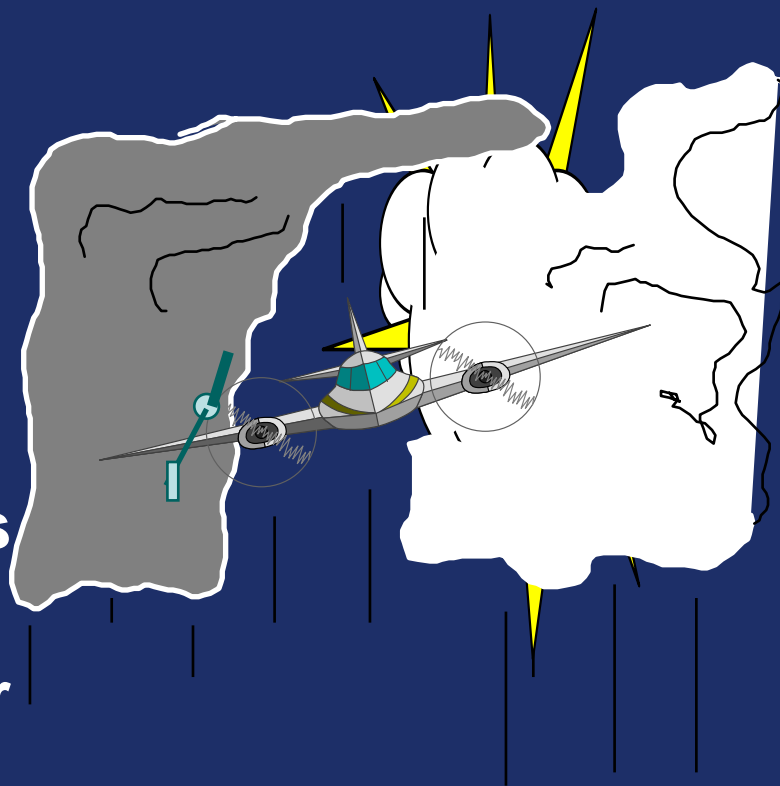
INSTRUMENT FLIGHT RULES

91.167 Fuel requirements for flight in IFR
conditions.
91.169 IFR flight plan: Information required.
91.171 VOR equipment check for IFR oper-
ations.
91.173 ATC clearance and flight plan re-
quired.
91.175 Takeoff and landing under IFR.

Instrument Flight Rules (IFR)

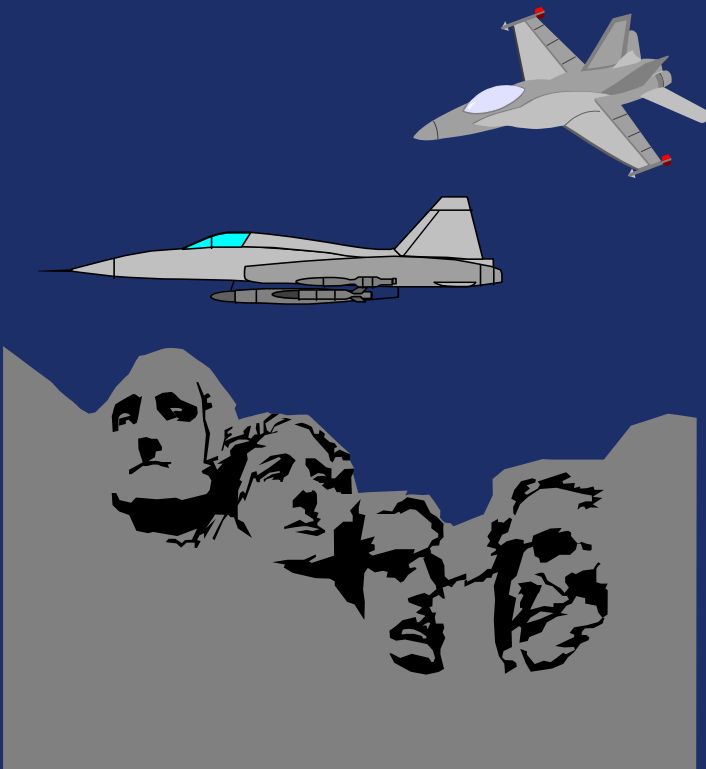
(14 CFR Part 91)

- Flight plan is required
- Contact with ATC mandatory
- Separated from other traffic by ATC
- Can fly in Instrument Meteorological Conditions (IMC) – low or no visibility
- IFR Clearance required for operations in Class A Airspace



Visual Flight Rules (VFR)

(14 CFR Part 91)



- Flight plan is optional
- Radio contact with ATC is voluntary, except in Class B, C and D airspace
- Pilot must see and avoid traffic
- Can fly only in good visibility, remaining clear of clouds
- VFR cloud clearance and visibility minimums vary with type of airspace

Flight Plan (14 CFR Part 91.169)

Pilots file a flight plan describing a precise route:

Instrument Flight Rules (IFR) Flight Plan information required includes:

- Flight description: Callsign, type aircraft, speed, altitude, fuel on board
- Airport Departure Procedure
- Routing Airways
- Airport Arrival Procedure

Flight Plan (14 CFR Part 91)

U.S. DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION FLIGHT PLAN		(FAA USE ONLY) <input type="checkbox"/> PILOT <input type="checkbox"/> VNR <input type="checkbox"/> STOPOVER			Form Approved OMB NO. 2120-0026 TIME STARTED		SPECIALIST INITIALS		
1. TYPE VFR X IFR DVFR		2. AIRCRAFT IDENTIFICATION AAL278		3. AIRCRAFT TYPE/ SPECIAL EQUIPMENT B-767/R		4. TRUE AIRSPEED 468 KTS		5. DEPARTURE POINT DFW	
						6. DEPARTURE TIME PROPOSED (Z) 1909 ACTUAL (Z)		7. CRUISING ALTITUDE 330	
8. ROUTE OF FLIGHT DFW.DALL8..TXK..LIT.J6.HVQ.CSN2.IAD									
9. DESTINATION (Name of airport and city) IAD				10. EST. TIME ENROUTE HOURS 3 MINUTES 15		11. REMARKS			
12. FUEL ON BOARD HOURS 4 MINUTES 30		13. ALTERNATE AIRPORT(S) JFK		14. PILOT'S NAME, ADDRESS & TELEPHONE NUMBER & AIRCRAFT HOME BASE				15. NUMBER ABOARD	
				17. DESTINATION CONTACT/TELEPHONE (OPTIONAL)					
16. COLOR OF AIRCRAFT				CIVIL AIRCRAFT PILOTS. FAR Part 91 requires you file an IFR flight plan to operate under instrument flight rules in controlled airspace. Failure to file could result in a civil penalty not to exceed \$1,000 for each violation (Section 901 of the Federal Aviation Act of 1958, as amended). Filing of a VFR flight plan is recommended as a good operating practice. See also Part 99 for requirements concerning DVFR flight plans.					

FAA Form 7233-1 (8-82)

CLOSE VFR FLIGHT PLAN WITH _____ FSS ON ARRIVAL

Weather Briefing / Sources

- **Flight Service Stations (FAA contracted to Lockheed Martin)**
 - Aviation weather reports, forecasts and advisories
 - NOTAMs (Notice to Airmen)
 - Flight plan filing
 - Inflight service via radio communications
- **Natl Weather Service Office**
- **DUAT (Direct User Access Terminal) – FAA contracted online preflight briefing and flight plan filing system**

Key FAA Directives and References

Based on regulations in 14 CFR (FARs):

- **FAA Order 7110.65 – Air Traffic Control**
 - Prescribes air traffic control procedures and phraseology
- **FAA Order 7210.3 – Facility Operation and Administration**
 - Instructions, standards, and guidance for operating and managing air traffic facilities and equipment
- **Aeronautical Information Manual (AIM)**
 - Basic flight information and ATC procedures
 - *AIM information is guidance, not regulation or rule

Air Traffic Control – 7110.65



U.S. Department
of Transportation
**Federal Aviation
Administration**

2/16/06

7110.65R

Order 7110.65R

Air Traffic Control

February 16, 2006

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NASA ATC Seminar
Ames Research Center
July 5-6, 2006

Facility Operation – 7210.3



U.S. Department
of Transportation
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Administration

16/06

7210.3

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Order 7210.3U

***Facility Operation and
Administration***

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Aeronautical Information Manual



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AIM

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Aeronautical Information

Manual Official Guide to Basic Flight Informa

An electronic version of this publication
<http://www.faa.gov/aim>

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Flight Information Publication Policy

The following is in essence, the statement issued by the FAA Administrator and published in the December 10, 1964, issue of the Federal Register, concerning the FAA policy as pertaining to the type of information that will be published as NOTAMs and in the Aeronautical Information Manual.

a. It is a pilot's inherent responsibility to be alert at all times for and in anticipation of all circumstances, situations, and conditions affecting the safe operation of the aircraft. For example, a pilot should expect to

c. The fact that the agency under one particular situation or another may or may not furnish information does not serve as a precedent of the agency's responsibility to the aviation community; neither does it give assurance that other information of the same or similar nature will be advertised, nor, does it guarantee that any and all information known to the agency will be advertised.

d. This publication, while not regulatory, provides information which reflects examples of operating

d. This publication, while not regulatory, provides information which reflects examples of operating techniques and procedures which may be requirements in other federal publications or regulations. It is made available solely to assist pilots in executing their responsibilities required by other publications.

International Civil Aviation Organization - ICAO



- United Nations affiliated aviation body
- Based on Convention on International Civil Aviation (also known as Chicago Convention) signed in 1944
- 189 Contracting States have agreed on numerous aviation conventions governing airspace operation, standardization, technical cooperation, etc.
- The US provides Air Traffic services for ICAO designated Flight Information Regions (FIRs) in the Atlantic, Pacific and Caribbean under ICAO rules.

Key ICAO Directives and References

- **DOC4444, Air Traffic Management**
 - Procedures for Air Navigation Services
- **DOC7030**
 - Rules of the Air, Air Traffic Services and Search and Rescue

Reference Link: <http://www.icao.int>

Questions?